PACIFIC WALRUS (*Odobenus rosmarus divergens*): Alaska Stock

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STOCK DEFINITION AND GEOGRAPHIC RANGE

The family Odobenidae is represented by a single modern species *Odobenus rosmarus* of which two subspecies are generally recognized: the Atlantic walrus (*O. r. rosmarus*) and the Pacific walrus (*O. r. divergens*) (Mansfield 1958, Fay 1982). The two subspecies occur in geographically isolated populations. The Pacific walrus is the only form occurring in U.S. waters and considered in this account. Pacific walrus mainly inhabit the continental shelf waters of the Bering and Chukchi seas, occasionally moving into the eastern East Siberian Sea and the western Beaufort Sea (Figure 1).

Figure 1. Distribution of the Pacific walrus. 1. Gulf of Anadyr. 2. Bristol Bay. 3. St. Lawrence Island. 4. Nunivak Island.

During the summer months, most of the population migrates into the Chukchi Sea, however thousands of animals, primarily adult males, congregate on or near terrestrial haulouts in the Gulf of Anadyr and in Bristol Bay. During the late winter breeding season, Pacific walrus are found in two major concentration areas of the Bering Sea where open leads, polynyas, or thin ice occur (Fay *et al.* 1984). While the specific location of these groups varies annually and seasonally depending upon the extent of the sea ice, generally one group ranges from the Gulf of Anadyr into a region southwest of St. Lawrence Island and a second group is found in the southeastern Bering Sea from south of Nunivak Island into northwestern Bristol Bay. Currently, animals in these two regions are assumed to represent a single stock. Mitochondrial and nuclear DNA analysis of tissue samples taken from animals in the two areas in April (shortly after breeding season) indicate that either they are not discrete breeding groups, or, that separation took place so recently that it is not yet genetically detectable (Scribner *et al.* 1997).

POPULATION SIZE

The current size of the Pacific walrus population is unknown. Fay (1957, 1982), Sease and Chapman (1988), and Fay *et al*. (1989), reviewed the history of population status and survey results from the beginning of commercial exploitation of Pacific walrus in the 18th century to the mid part of this century. More recently, Fay *et al*. (1997) estimated population status for the period 1950 to 1989. The actual size of the pre-exploitation population is unknown, but has been estimated to have been between 200,000-250,000 animals. Over the past 150 years, the size of the Pacific walrus population has fluctuated markedly, presumably in response to varying levels of commercial exploitation. Since the most recent reduction to an estimated 50,000-100,000 animals in the mid-1950s, the population has increased under various protective measures implemented by the U.S. and Russia (the former Soviet Union).

Cooperative aerial surveys by the U.S. and Soviet Union (now Russia) were initiated in 1975 under the auspices of the 1972 *Agreement on Cooperation in the Field of Environmental Protection.* The 1975 survey estimated the population size at 221,360 (Gol'tsev 1976, Estes and Gilbert 1978, Estes and Gol'tsev 1984). A second joint census, conducted in 1980, estimated population size at 246,360 (Johnson *et al.* 1982, Fedoseev 1984). A third survey, conducted in 1985, produced a population estimate of 234,020 (Gilbert 1986, 1989 a,b, Fedoseev and Razlivalov 1986). The most recent aerial survey, flown in 1990, produced an estimate of 201,039 (Gilbert *et al.* 1992), however a considerable portion of the eastern Chukchi Sea usually inhabited by walrus in more typical ice years was not surveyed because ice was not present. The estimates generated from these surveys should be viewed as conservative population estimates that are not useful for detecting

population trends (Hills and Gilbert 1994, Gilbert *et al.* 1992). Cooperative aerial surveys were suspended in 1995 due to budget limitations and unresolved methodological problems (See Estes and Gilbert 1978 for a review).

Minimum Population Estimate

Following the guidelines of the Potential Biological Removal workshop (Wade and Angliss 1997), the minimum population estimate (N_{MIN}) for Pacific walrus was calculated based upon the most recent (1990) survey data. Direct counts of walrus on land haulouts in the U.S. and Russia were added to minimum abundance estimates for walrus on ice and in water to calculate N_{MIN}. Minimum abundance estimates for ice and water strata were based upon the lower bounds of the 20th percentile of a log normal distribution of stratum estimates with calculated coefficients of variation. Using this approach, N_{MIN} for Pacific walrus is 188,316 (Table 1).

Table 1. Calculation of estimated minimum population size for Pacific walrus based on 1990 survey information (Gilbert *et al.* 1992). For stratum estimates with calculated coefficients of variation (C.V.), the minimum estimate is the lower bound of the 20th percentile of a log-normal distribution of the strata estimate.

Habitat	Stratum	Estimated Abundance	C.V.	Minimum Estimate
Ice	A	3,352	0.64	2,047
	B	256	0.48	174
	C	48	1,39	20
	D	1,639	0.81	901
	E	7,189	1.20	3,246
	F	3,603	0.58	2,290
	G	402	1.16	185
	Subtotal	**16,489**		**8,862**
Water	Y	2,403	0.86	1,284
	Z	10,734	0.59	6,757
	Coastal	9,366	-	9,366
	Subtotal	**22,503**	**-**	**17,406**
Land		**162,047**	**-**	**162,047**
Total		**201,039**	**N_{MIN}**	**188,316**

Current Population Trend

Differences in survey design and methodologies preclude describing any clear trend in population size (Hills 1992, Hills and Gilbert 1994).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

The current net productivity rate of the Pacific walrus population is unknown. Estimates of net productivity rates for walrus populations range from 3-13% per year, with most estimates falling between 5-10% (Chapskii 1936, Mansfield 1959, Krylov 1965, 1968, Fedoseev and Gol'tsev 1969, Sease 1986, DeMaster 1984, Sease and Chapman 1988, Fay *et al.* 1990, Fay *et al.* 1997).

The theoretical maximum net productivity rate (R_{MAX}) for walrus is also unknown. Stock assessment guidelines recommend using a default R_{MAX} value of 12% for pinniped species when R_{MAX} is not known (Wade and Angliss 1997). An R_{MAX} value of 12% may be too high for walrus; although walrus are long-lived and appear to have low rates of natural mortality, they produce a maximum of one calf every two years while most other pinniped species are annual breeders

(Fay 1982). The Fish and Wildlife Service (FWS) and the Biological Resources Division of the U.S. Geological Survey are currently supporting research and modeling efforts to improve estimates of net productivity. Until additional data become available from which more accurate estimates of population growth can be determined, the FWS has adopted a theoretical R_{MAX} value of 8% for this stock. While there are currently no data to support this specific rate, the estimate appears reasonable considering the range of published estimates of net productivity for walrus populations (3-13%).

POTENTIAL BIOLOGICAL REMOVAL

Based on Wade and Angliss (1997), the potential biological removal (PBR) level was calculated as the product of the minimum population estimate (N_{MIN}), one-half the maximum theoretical net productivity rate (R_{MAX}) and a recovery factor. A recovery factor (F_R) of 1.0 was chosen for this stock since the population is believed to be within Optimal Sustainable Population (OSP) levels. The PBR level derived from this information is 7,533 walrus per year (188,316 x 0.04 x 1).

ANNUAL HUMAN CAUSED MORTALITY

Fisheries Information

Although there are no reliable data available concerning the incidental catch of Pacific walrus in fisheries operating in Russian waters, the level of take is believed to be small (*pers. comm.* Valeriy Vladimirov, VNIRO Marine Mammal Laboratory, Moscow). In the U.S. regulatory zone, walrus have been reported to be taken incidentally in the domestic groundfish trawl fisheries of the eastern Bering Sea (Appendix II Table c, Hill *et al.* 1997). Fisheries observer data collected by the National Marine Fisheries Service (NMFS) between 1992 and 1996 indicates that the mean number of walrus caught per year was 16.6 animals (range 8-25) (Unpublished data, Michael Perez, NMFS, NMML, 7600 Sand Pt. Way, NE, Seattle, WA 98115). In the cases where sex was identified, all of the take consisted of adult males. Most (80%) were already decomposed upon catch, indicating that at least a portion of the catch consisted of individuals whose mortality was unrelated to fisheries interactions (e.g. harvest loss or natural mortality). Only three live takes were recorded over this period. Based on these data, the estimated level of incidental take associated with commercial fisheries in U.S. waters is approximately 17 walrus per year (>1% of PBR). At the present time, this mortality rate is far below the 10% of PBR level proposed by NMFS as "insignificant levels of mortality and serious injury approaching a zero rate."

Subsistence Harvest

Fay and Bowlby (1994), present walrus harvest data for the U.S. and Russia between 1931 and 1988. Harvest data for the period 1989-1996 were collected by then FWS in U.S. waters, and by Magadan Okhotskrybvod (Fisheries Inspection Service) in Russia. An analysis of the number of walrus struck and lost during monitored subsistence hunts concluded that approximately 42% of the animals struck by bullets were lost, and that very few animals struck and lost recovered from their wounds (Fay *et al.* 1994). Overall, the combined total U.S./ Russian harvest (including an estimated 42% struck and lost) over the past 36 years has averaged 7,334 walrus per year (range 3,200-16,100). Harvest levels are substantially lower in the 1990s than in the previous decade (Figure 2). Possible factors affecting this decline include: the cessation of Russian ship-based harvests; changing political, economic, and social conditions affecting hunters; as well as the influence of weather and ice conditions on hunting success.

The FWS has adopted the average annual harvest over the past 5 years (1992 through 1996) as the estimate most representative of the current harvest level. Between 1992 and 1996, the combined annual harvest of the U.S. and Russia (including a 42% struck and lost rate) averaged 4,869 walrus per year (Table 2). The sex ratio of the reported U.S. harvest over this period was approximately equal. Unfortunately, the sex ratio of the Russian harvest was not recorded, and harvest data may have been

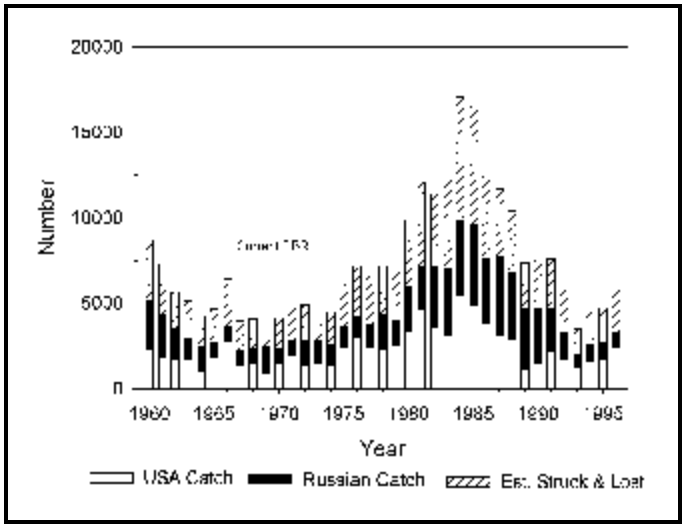

Figure 2. Harvest of Pacific walrus, 1960 - 1996.

under reported (*pers. comm.* Yuri Bukhtiyarov, TNIRO Marine Mammals Laboratory of Magadan). It is essential that harvest monitoring in both nations be maintained in order to accurately assess the impact of the harvest to this stock. In 1997, a Cooperative Agreement was developed between the FWS and the Eskimo Walrus Commission to implement Section 119 of the Marine Mammal Protection Act. This Agreement facilitates local participation in activities related to the conservation and management of walrus including participation in activities such as harvest monitoring. In the future, harvest monitoring programs in Russia may be strengthened through international conservation agreements between the United States and Russia.

Table 2. Estimated harvest of Pacific walrus, 1992-1996. Russian harvest information provided by Okhotskrybvod (Fisheries Inspection Service), Magadan, Russia. U.S. harvest information was collected by the U.S. Fish and Wildlife Service, Marine Mammals Management Office, Anchorage, Alaska, and are adjusted for unreported walrus (Garlich-Miller and Burn 1997). Corrected harvest incorporates a 42% struck and loss rate from Fay *et al.* (1994).

Year	Reported Russia Harvest	Reported U.S. Harvest	Total Reported Harvest	Total Corrected Harvest
1992	1,670	1,683	3,353	5,781
1993	856	1,183	2,039	3,516
1994	1,013	1,611	2,624	4,524
1995	1,071	1,674	2,745	4,732
1996	941	2,419	3,360	5,794
Mean	**1,110**	**1,714**	**2,824**	**4,869**

Other Removals

Other sources of human caused removal between 1992 and 1997 have included: the collection of 14 walrus calves (<3 calves/yr) for public display; the occasional rescue of stranded animals (<1 /yr); and the potential mortality from authorized ("small take" regulations) industrial activities in the Chukchi Sea (there has been only 1 documented mortality since 1988). Based on this information, approximately 4 walrus per year were taken due to "other" human activities.

Total Estimated Annual Human Caused Mortality

Based on the information above, the total estimated annual human caused mortality is calculated to be 4,890 walrus per year (17 due to fisheries, 4,869 due to harvest, 4 due to other removals).

STATUS OF STOCK

In spite of an inability to determine precisely the bounds of OSP as currently defined, the population is believed to be within OSP given the large 1990 population estimate (Fay *et al.* 1990, Gilbert *et al*. 1992, FWS 1994). The Pacific walrus currently has an estimated mean annual level of human mortality and serious injury of 4,890 walrus per year; that value is less than the calculated PBR rate of 7,533. Therefore the stock has been determined to be "non-strategic."

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